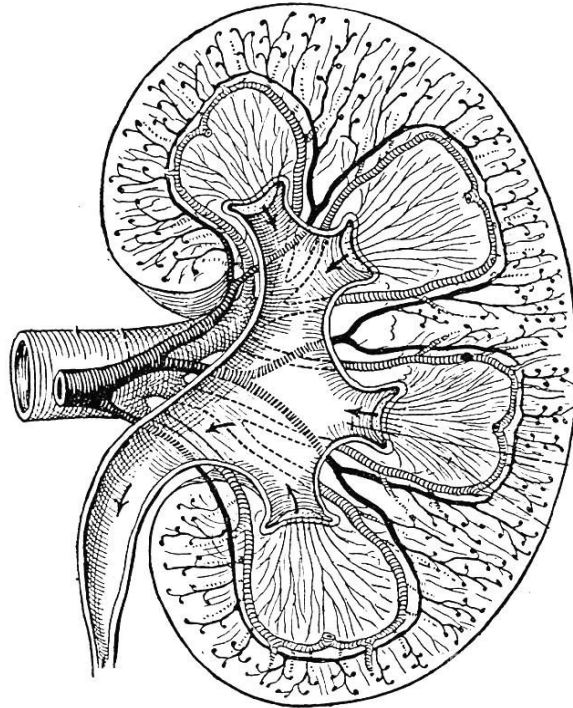


PRACTICAL MICROBIOLOGY

Made For 435's Renal SAQ & OSPE Exams



This work is produced to encourage **analytical understanding** by connecting **theoretical** and **practical** knowledge with clinical case scenarios that are possibly going to be asked about within MCQs, SAQs or OSPE exams. This work has been **voluntarily made**; do not hesitate to communicate your questions, corrections and suggestions to us.

- الإضافات الجديدة باللون الأزرق، نعتذر منكم ونقدر تفهمكم -

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INTRODUCTION

Every clinical scenario is a puzzle... Ask yourself, which is easier?

- A. Knowing the structure of every single piece of the puzzle then putting it all together.
- B. Knowing the big picture of the puzzle then logically fixing the pieces back in place.

If your answer is B, you're gonna enjoy the heck out of this document!

If your answer is A, well, you can still join...

First of all, we need to agree that what we are going to do is a **step by step** technique.

By the end of this document, we will:

1. Realize the most common structure of any given clinical UTI scenario.
2. Have an idea about the most commonly questionable corners regarding UTIs.
3. Interact our theoretical knowledge with practical Microbiology.
4. Practice SAQ and OSPE ourselves.



Urinary Tract Infections

(Brief Revision)

● Uncomplicated UTI

Infection in a healthy patient with normal genitourinary tract.

● Complicated UTI

Infection associated with factors that increase chance of acquiring bacteria and decrease efficacy of therapy. Also requires one or all of following:

- 1) Abnormalities (benign prostatic hyperplasia, stone, neurogenic bladder... etc.)
- 2) Immunocompromised host (diabetic, HIV, receiving chemotherapy... etc.)
- 3) Multi-drug resistant bacteria (*Pseudomonas Aeruginosa*, *Acinetobacter*... etc.)

	Cystitis	Pyelonephritis
Signs & Symptoms	<ul style="list-style-type: none"> ● Strong, persistent urge to urinate (urgency). ● Painful feeling with urination (dysuria). ● Passing frequent, small amounts of urine. ● Blood in the urine (hematuria). ● Pelvic discomfort. ● Suprapubic pain. 	<ul style="list-style-type: none"> ● Fever. ● Chills. ● Flank pain. ● Nausea and vomiting. ● Costovertebral angle tenderness. ● WBC & bacteria.

STEP ONE: Clinical scenarios

For any clinical scenario, a set of hints is right on the paper in front of you, just **READ**. What we are trying to achieve is a mechanism that will keep us focused while reading clinical scenarios in order to prevent us from skipping any useful information given.

Personal information, complaint, clinical and personal history, clinical examination results, laboratory investigations results, diagnostic radiology results.

A. Personal information

Age:

UTIs are more common in elderly than in youth. However, note the risk factors:

If it's a child → congenital abnormalities leading to vesicoureteral reflux (VUR).

If it's an adult → pregnancy, sexual intercourse, catheterization or obstruction.

If it's an elderly → benign prostatic hypertrophy (male) or menopause (female).

Gender:

Females are more susceptible in almost all UTIs (in the absence of catheterization).

Nationality/occupation:

People of endemic areas usually acquire UTIs of *Schistosoma Haematobium* etiology.

B. Complaint

Difficulty urinating (dysuria), frequency and urgency → Cystitis

Cloudy urine, chills, fever, back pain (flank pain) and dysuria → Acute pyelonephritis

Mental confusion → Acute pyelonephritis in elderly

Complaining from a disease that is not renal related¹ → Chronic pyelonephritis

C. Clinical and personal history

Complaining from renal stones → *Proteus* Cystitis

Hospitalized on a renal catheter → *Pseudomonas* Cystitis

Female just arrived from her honeymoon → *Staphylococcus Saprophyticus* Cystitis

Multiple sexual partners → *Neisseria gonorrhoea* or *chlamydial* Cystitis

Patient with a *Staph. aureus* or *TB* infection → Haematogenous pyelonephritis

¹ They find the renal manifestations by coincidence (throughout routine tests).

D. Clinical examination results

Suprapubic pain → Cystitis

Flank pain and cortical angle tenderness → Pyelonephritis

E. Laboratory investigation results (deeply discussed in step three)

Urine (for cystitis and acute pyelonephritis²):

Positive nitrite dipstick → Gram -ve bacteria³ is present in urine

Positive leukocyte esterase dipstick → Pus cells are present in urine (pyuria)

10⁵ microorganisms/ml of urine → Significant bacteriuria (UTI)⁴

Blood (for acute pyelonephritis only):

Isolated *Staph. aureus* or TB → Positive bacteremia causing hematogenous spread

F. Diagnostic radiology result:

Showing a late stage vesicoureteral reflux → reflux-induced chronic pyelonephritis⁵

Shrunken kidneys → chronic pyelonephritis

² Chronic pyelonephritis does not usually have any laboratory manifestations but raised serum creatinine.

³ Gives a negative result if the organism was gram +ve. Be careful.

⁴ It may not be present in cases of chronic pyelonephritis.

⁵ Pathology.

STEP TWO: Questions

Weather in SAQs or OSPE, you are -most likely- expected to answer the following:

1. What is your differential diagnosis?
 2. Identify the causative agent.
 3. Describe the characteristics seen under microscope.
 4. Name the stain used under microscope.
 5. Describe the characteristics seen on plate (media).
 6. Name the plate (media) of which the organism grows on.
 7. Name the best detection methods used for further investigations.
 8. Name the treatment(s) used for such disease.
 9. Some pharmacology questions may follow the treatment.
 10. Name the complications that may be associated with the disease.
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STEP THREE: Practical Microbiology

As far as this step, we should -hopefully- be capable of all the theoretical information needed to differentiate the diagnosis. Fortunately, both cystitis and pyelonephritis have the same set of causative agents, so, knowing the microbiological information of each one of the common microorganisms is all you need to focus on.

The process goes as following:

1. Collect an appropriate urine sample.
 2. Do your biochemical tests for nitrite and leukocyte esterase.
 3. Culture the urine sample.
 4. Detect the sample with microscopy.
 5. For pyelonephritis, add a blood culture to the steps above.
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Urine sample collection

Q: What is the best method of urine sample collection for this case?

If a child → Adhesive bag or suprapubic aspiration

If an adult → Midstream urine (clean catch), if not possible, use suprapubic aspiration

NEVER take the sample from a urinary catheter because it is usually contaminated

Biochemical tests

Q: What further investigations would you request for the case?

Dipstick test → 1) Nitrite 2) leukocyte esterase

Scenario: dipstick shows positive nitrite.

It is a gram -ve microorganism in the urine (indicates UTI)

Scenario: dipstick shows negative nitrite.

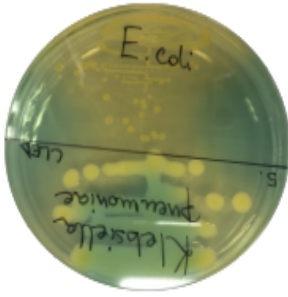
We cannot rule out UTI cause gram +ve do not produce nitrite.

If another clue is confirming a UTI in the scenario, this must indicate either

Staphylococcus Saprophyticus Cystitis or *Staphylococcus Aureus* acute pyelonephritis

Escherichia Coli

(All the information following can be either given in the scenario or questioned)



CLED Agar



MacConkey's agar



Gram stain



Urease test



Indole test

Q: Describe the microscopic appearance.

Gram stain showing gram -ve rods, *E. Coli*.

Q: What further investigations do we use to identify the microorganism in this case?

- 1) Culture on CLED agar
- 2) Culture on MacConkey's agar
- 3) Urease test
- 4) **Indole test⁶**

Q: Describe the organism's appearance on CLED agar.

Lactose positive yellow colonies.

Q: Describe the organism's appearance on MacConkey's agar.

Lactose fermenter (pink colonies).

Q: Describe the organism's urease test.

Urease negative.

Q: Describe the organism's Indole test.

Indole positive.

Q: What is your differential diagnosis?

Fever → Acute pyelonephritis

No fever → Cystitis

Q: What is the best treatment used for this case?

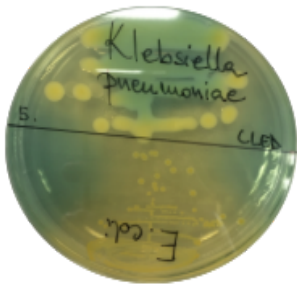
1st line (Empiric): oral Trimoxazole for 3 days or oral Nitrofurantoin for 7-10 days.

If pregnant: oral Cefixime, intravenous Ceftazidime or intravenous Ceftriaxone.

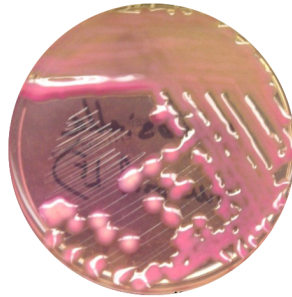
⁶ to differentiate between it and klebsiella

Klebsiella pneumoniae

(All the information following can be either given in the scenario or questioned)



CLED Agar



MacConkey's agar



Gram stain



Urease test



Indole test

Q: Describe the microscopic appearance.

Gram stain showing → gram -ve rods, *klebsiella pneumoniae* (similar to *E.coli*).

Q: What further investigations do we use to identify the microorganism in this case?

1. Culture on CLED agar
2. Culture on MacConkey's agar
3. Urease test
4. Indole test

Q: Describe the organism's appearance on CLED agar.

Lactose positive (yellow **mucoïd** colonies).

Q: Describe the organism's appearance on MacConkey's agar.

Lactose fermenter (pink **mucoïd** colonies).

Q: Describe the organism's urease test.

Urease positive.

Q: Describe the organism's Indole test.

Indole Negative.

Q: What is your differential diagnosis?

Fever → Acute pyelonephritis

No fever → Cystitis

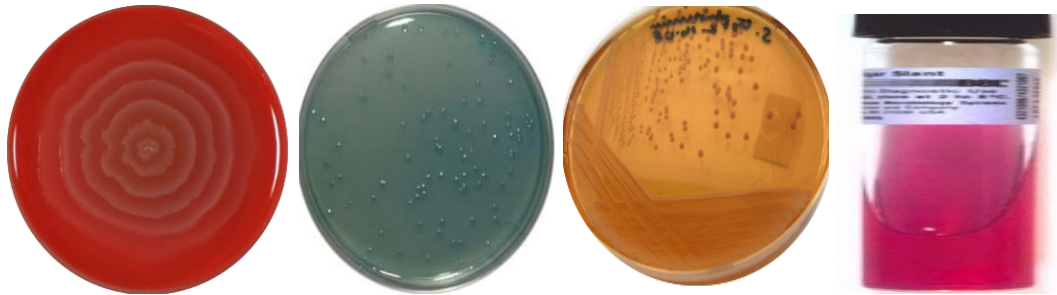
Q: What is the best treatment used for this case?

1st line (Empiric): oral Trimoxazole for 3 days or oral Nitrofurantoin for 7-10 days.

If pregnant: oral Cefixime, intravenous Ceftazidime or intravenous Ceftriaxone.

Proteus

(All the information following can be either given in the scenario or questioned)



Blood Agar

CLED agar

MacConkey's agar

Urease test

Q: What further investigations do we use to identify the microorganism in this case?

1. Culture on Blood agar
2. Culture on CLED agar
3. Culture on MacConkey's agar
4. Urease test
5. Urine pH level test

Q: Describe the organism's appearance on blood agar.

Swarming growth.

Q: Describe the organism's appearance on CLED agar.

Swarming growth is inhibited, (Blue) Slightly elevated.

Q: Describe the organism's appearance on MacConkey's agar.

Non-lactose fermenter (pale colonies).

Q: Describe the organism's urease test.

Urease positive.

Q: What is the suspected urine pH level with the presence of such microorganism?

Alkaline urine, empowers the formation of urinary tract stones.

Q: What is your differential diagnosis?

Fever → Acute pyelonephritis

No fever → Cystitis

Q: What is the best treatment used for this case?

Gentamycin

Pseudomonas Aeruginosa

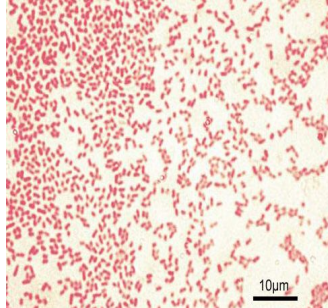
(All the information following can be either given in the scenario or questioned)



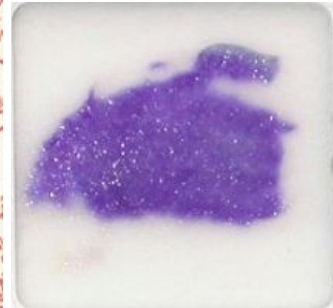
MacConkey's agar



Nutrient agar



Gram stain



Oxidase test

Q: Describe the microscopic appearance.

Gram stain showing gram -ve rods, *Pseudomonas Aeruginosa*.

Q: What further investigations do we use to identify the microorganism in this case?

- 1) Culture on MacConkey's agar
- 2) Culture on Nutrient agar
- 3) Oxidase test

Q: Describe the organism's appearance on MacConkey's agar.

Non-lactose fermenter.

Q: Describe the organism's appearance on nutrient agar.

Produced pyocyanin pigment (blue green colonies).

Q: Describe the organism's oxidase test.

Oxidase positive.

Q: What is your differential diagnosis?

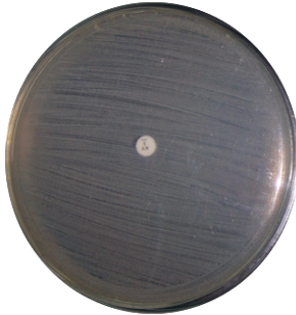
Nosocomial, multidrug resistant complicated UTI.

Q: What is the best treatment used for this case?

Ciprofloxacin.

Staphylococcus Saprophyticus

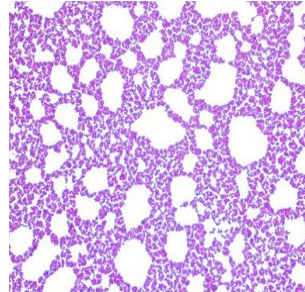
(All the information following can be either given in the scenario or questioned)



Novobiocin sensitivity



Blood agar



Gram stain



Coagulase test

Q: Describe the microscopic appearance.

Gram stain showing gram +ve cocci in clusters, *Staphylococcus Saprophyticus*.

Q: What further investigations do we use to identify the microorganism in this case?

- 1) Novobiocin sensitivity test
- 2) Culture on blood agar
- 3) Coagulase test

Q: Describe the organism's appearance on Novobiocin sensitivity test.

Shows resistance.

Q: Describe the organism's appearance on blood agar.

White colonies.

Q: Describe the organism's coagulase test.

Coagulase negative.

Q: What is your differential diagnosis?

Uncomplicated UTI.

Fever → Acute pyelonephritis

No fever → Cystitis

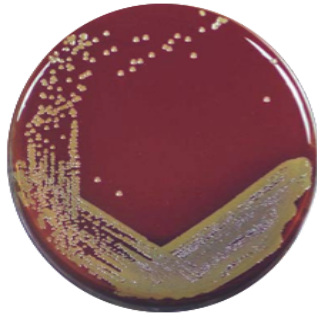
Q: What is the best treatment used for this case?

1st line (Empiric): oral Trimoxazole for 3 days or oral Nitrofurantoin for 7-10 days.

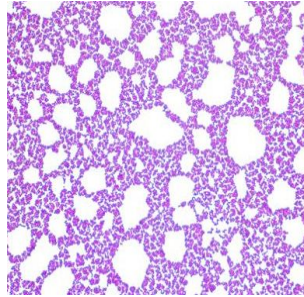
If pregnant: oral Cefixime, intravenous Ceftazidime or intravenous Ceftriaxone.

Staphylococcus Aureus

(All the information following can be either given in the scenario or questioned)



Blood agar



Gram stain



Coagulase test

Q: Describe the microscopic appearance.

Gram stain showing gram +ve cocci in clusters, *Staphylococcus Aureus*.

Q: What further investigations do we use to identify the microorganism in this case?

- 1) Blood culture
- 2) Culture on blood agar
- 3) Coagulase test

Q: Describe the organism's appearance on blood agar.

Gold colonies.

Q: Describe the organism's Coagulase test.

Coagulase positive.

Q: What is your differential diagnosis?

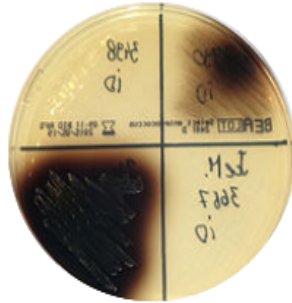
Hematogenous spread acute pyelonephritis.

Enterococcus faecalis

(All the information following can be either given in the scenario or questioned)



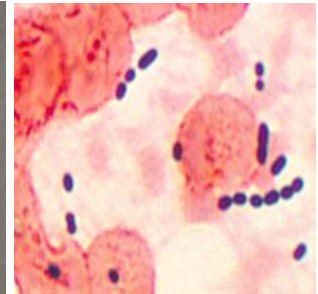
Blood agar



Bile Esculin Agar



Catalase test



Gram stain

Q: Describe the microscopic appearance.

Gram stain showing gram +ve cocci in short chains or pairs.

Q: What further investigations do we use to identify the microorganism in this case?

- 1) Culture on blood agar
- 2) Culture on Bile Esculin Agar (BEA⁷)
- 3) Catalase test

Q: Describe the organism's appearance on blood agar.

Non-hemolytic (gamma-hemolytic) colonies.

Q: Describe the organism's Catalase test.

Catalase negative.

Q: Describe the organism's Bile Esculin Agar.

Enterococcus are capable of growing and produce a black complex⁸.

Q: What is your differential diagnosis?

Complicated UTI:

1. Hospital acquired.
2. Ascending Infection (or VUR reflux).

Q: What are the possible complications that associate this organism?

Bacteremia, Endocarditis and Meningitis.

⁷ To differentiate between Enterococcus and Streptococcus because both are -ve for catalase.

⁸ Hydrolyzing esculin to glucose and esculetin. Esculetin combines with ferric ions to produce a black complex

STEP FOUR: PRACTICE

Print out this [PRACTICE TEST](#) and examine your understanding.

You can use this [ANSWERED SHEET](#) to check and compare.

We wish you the best of luck

اللَّهُمَّ اجْعَلْ خَيْرَ أَعْمَالِنَا خَوَاتِيمَهَا